

ARRL EMC Committee Semi-Annual Report

Doc. # 20

**For The
American Radio
Relay League**

**Board of Directors Meeting
January 18-19, 2013**

**Submitted By
Kermit Carlson, W9XA
Chairman, ARRL EMC Committee**

Mission Statement:

The EMC Committee monitors developments in the Electromagnetic Compatibility (EMC) field and assesses their impact on the Amateur Radio Service. The Committee informs the ARRL Board of Directors about these activities and makes policy recommendations for further action, if appropriate.

The overall goals of the committee are:

- Advise the ARRL Board about issues related to radio-frequency interference
- Advise the ARRL HQ staff on the content of its publications
- Make recommendations to the ARRL Board and HQ staff
- Maintain contact with other organizations involved in EMC matters through established liaison individuals

Members of the Committee:

- Mr. Kermit Carlson, W9XA, ARRL Central Division Vice Director, EMC Committee Chairman
- Mr. Gordon Beattie, W2TTT, Principal Technical Architect, AT&T Enterprise IT Service Assurance
- Mr. Jody Boucher, WA1ZBL, RFI troubleshooter, Northeast Utilities
- Mr. Brian Cramer, PE, W9RFI, Electrical Interference Solutions, Inc.
- Mr. Mike Gruber, W1MG, ARRL Lab RFI Engineer, HQ Staff Liaison
- Mr. Ed Hare, W1RFI, ARRL Laboratory Manager
- Mr. Ron Hranac, N0IVN, Technical Leader, Cisco Systems; past member of the Board of Directors, Society of Cable Telecommunications Engineers
- Mr. Richard D. Illman, AH6EZ Senior Engineer, Motorola Solutions
- Mr. Steve Jackson, KZ1X, VDSL and wireless communications
- Mr. John M. Krumenacker, KB3PJO Design Engineer
- Dr. Ron McConnell, W2IOL, T1E1.4 VDSL Standards Committee

- Mr. Jerry Ramie, KI6LGY, ARC Technical Resources, Inc.
- Mr. Cortland Richmond, KA5S, EMC Engineer
- Mr. Mark Steffka, WW8MS, Automotive EMC engineer
- Dr. Steve Strauss, NY3B, Home Phone Networking Alliance Technical Committee

Recent EMC Committee Activity and Discussion:

The EMC Committee held three Webinar and Telephone Conferences during the second half of last year. The latest one was on December 6, 2012. Topics of discussion included:

- Mr. Gruber reported on FCC enforcement, particularly with regard to inadequate enforcement of cases involving power line noise. He also provided some background information on the rules and ongoing testing of LED bulbs. Additional details on these topics are included later in this report.
- Testing of hybrid automobiles.
- Smart Grid and related standards

HQ Staff:

The role of the ARRL HQ staff consists of the following:

- Answer individual inquiries from hams (and sometimes their neighbors) about RFI problems
- Write and publish articles about RFI
- Write and publish the ARRL RFI Book
- Design and update ARRL's RFI web pages
- Maintain a database at ARRL to facilitate EMC case tracking and reporting
- Work with ARRL's D.C. office on various spectrum and RFI-related filings
- Maintain contact with industry
- Participate in standards and industry groups, as a voting member or as a liaison. This includes ANSI accredited C63[®], Society of Automotive Engineers EMC and EMR committees, Home Phone Networking Alliance, VDSL, HomePlug, FCC and individual companies.

Mr. Gruber handles the majority of the staff work on EMC matters. In the 2nd half of 2013, he also continued with work in a number of key areas:

- Adding updates and revisions to the ARRL RFI Web pages.
- Facilitating and providing assistance on resolving long standing power line noise cases with the FCC.
 - Of particular note is a case near Pittsburgh, PA. Although this case was first reported to the ARRL in 2003, and the FCC has written the utility five letters concerning the matter, it is clear the utility still lacks the proper equipment and expertise to correct the problem. Mr. Gruber, with assistance from Mike Martin of RFI Services, helped the FCC investigate

the noise in May of 2011. Several sources were found and reportedly fixed by the utility. The utility however is unable to find the remaining sources. They point to a sign as the culprit, which is a tactic they had used previously. Although the complainant reports he was never contacted by the utility after the FCC's letter in 2011, this case was closed and a new case opened on it. Questions concerning sources during a recent visit by Mr. Hare prompted this decision. The complainant has borrowed the ARRL locating equipment and conducting an investigation. This case was also the subject of an ARRL News article when the utility told the complainant that they wanted to charge him for locating the noise several years ago.

- Testing the conducted emissions of suspect consumer electronic and electrical devices. Devices that exceed FCC specified absolute limits can be identified and reported to the FCC. Of particular concern are:
 - LED Part 15 Bulbs, which may meet Part 15 limits, but if at or near the limits, could present an RFI problem without a practical solution, especially if there are many bulbs that are contributing to the problem. As an example, a device at FCC limits could be in the range of several homes in a typical suburban environment. When considering bulbs, a conservative estimate might be 50 bulbs per household, thus putting 150 or more bulbs within range of an Amateur station with just two neighboring homes.
 - Non-consumer Part 18 electronic ballasts being marketed and sold for consumer and residential purposes.
 - Variable speed pulsed DC motors now appearing in such things as washing machines, HVAC systems and pool pumps. Furnaces and air conditioners seem to be particularly problematic.
 - Large grow lighting devices used for indoor gardening are particularly problematic in some parts of the country, especially California and Colorado. These devices can be heard at much greater distances than would normally be expected from a device that meets the FCC Part 15 or 18 limits. One light that we looked at, for example, was considerably over the limit.
- Working with AT&T engineering staff to help resolve RFI issues with U-Verse systems.
- Reviewing proposed EMC related material for ARRL publications, including the RFI Chapter in the 2014 ARRL Handbook.

Summary of Recent and Ongoing Lab Activities

Pertaining to Part 15 & Part 18 Lighting Devices, Mr. Gruber reports that he completed of testing of six additional Part 18 bulbs for conducted emissions. This raises the total number of bulbs tested to 39. The selection of bulbs now includes:

- 30 LED bulbs from a variety of retail outlets, Dayton and eBay sources.
Note: One LED bulb marked Part 18.

- 2 red LED (used) traffic lights purchased at Dayton.
- 7 CFL bulbs in various configurations, including floodlights. These bulbs are similar in configuration to the Part 15 LED bulbs that were selected for this testing.

Mr. Gruber adds that LED bulbs operate under are Part 15, while CFL's and electronic fluorescent light ballasts typically Part 18. In this case, there is an important distinction between these two rules - *Part 18 limits for consumer RF lighting device lower than applicable Part 15 limits*. As a consequence, the ARRL Board has previously asked us to look at proposal to reduce Part 15 limits to Part 18 levels for lighting devices.

The results and data from this testing will provide us with a better understanding of interference potential from LED bulbs as they currently exist. Initial analysis suggests they substantially meet the applicable Part 15 or Part 18 limits. It is important to note, however, that these limits high enough to create interference issues. Mr. Gruber emphasizes that even if an LED bulb is near the Part 15 limit, it can still be legally be sold and marketed. If and when interference occurs, the burden falls on operator to correct problem. While this rule may work on a case-by-case basis for a small or limited number of sources, it is not practical should many bulbs in several houses be contributing to a wide spread problem.

In addition, according to the FINAL REPORT ON THE 4TH JOINT CROSS-BORDER EMC MARKET SURVEILLANCE CAMPAIGN (2011), a study that they did on LED Lighting products in Europe found that:

- There was rather low compliance with the emissions limits: 61.5% of the tested, one hundred and sixty-six (166) products were found to be compliant.
- An additional study on harmonic current emissions was carried out. When applying the same harmonic limits as those for compact fluorescent lamps, one out of two samples, 46% of the assessed LED lighting equipment failed.

A complete copy of this report is included as Appendix A in the report, or on-line at:

http://ec.europa.eu/enterprise/sectors/electrical/files/emc/ms-campaign-fourth_en.pdf

Status On FCC Enforcement and Outstanding EMC Cases

Mr. Gruber reports that the FCC has been sending letters to utilities (and consumers) with some regularity. Meaningful enforcement beyond that, however, has been very disappointing. No previously reported longstanding case has been resolved during the second half of 2012. Looking at total picture, less than 20% of the known FCC power line cases have been resolved since the beginning of 2009.

As previously reported, here are some approximate statistics after ten years:

- 3,500 total RFI cases.
- 1,000 Power Line Noise cases. Note: There are likely to be more since approximately 1/3 unknown sources are power line noise.
- 180 cases involved one or more FCC letters.
- 52 cases involved 2 or more FCC letters.

Here are some FCC Statistics from January 2009 to December 2011:

- 73 letters sent involving Power Line Noise.
- 50 cases remain ongoing. Note: It is possible that some of these cases have been corrected but not reported as such to ARRL.
- 13 and possibly 14 cases known to be fixed.
- 2 complainants moved.
- 3 cases involve an unknown status.
- 1 case on hold.
- 3 cases disregarded. Note: Reasons might include inappropriate behavior or lack of complaint credibility.

In summary, Mr. Gruber reports the following comments concerning FCC enforcement:

- Less than 20% of the PLN cases involving the FCC from 2009 to 2011 are now fixed.
- Some cases have lingered for many years without satisfactory resolution.
- Cases are often caught in an endless loop or letter writing campaign.
- Of the approximately 1,000 ARRL power line noise cases, the FCC
 - Has never issued even one NAL.
 - Issued only about 4 citations. Note: Remarkably, the same noise level that prompted the Lakeland citation was later deemed not to meet FCC's criteria to be harmful interference.
- Present protracted power line noise case examples include cases in Pittsburgh, Lakeland and Colorado. It is important to note that Mr. Gruber was personally able to find noise at each of these locations in less than one hour of looking.
- Bottom Line: The FCC is clearly not doing its job!

Second Half 2012 Year Total RFI-Case Statistics:

New RFI Cases – 101

New electrical power-line cases – 21

- ARRL Letters sent – 11 (Note: One letter involved four complainants.)
- FCC 1st Letters submitted – 6 (Note: Laura Smith may have issued FCC letters based on need and input from the ARRL. These letters were not formally submitted by ARRL and therefore not included in this total. Many of these letters were follow-up in nature and therefore required custom legal language. The effectiveness of these letters has yet to be determined.)
- FCC 2nd Letters submitted – 2

Electric Utilities:

Power-line interference has continued to be the single number one known interference problem reported to ARRL HQ. It can also be one of the most difficult to solve. Fortunately, Laura Smith clearly remains interested in RFI matters and continuing with the Cooperative Agreement. In addition, the Committee is continuing in the process of forming a working group to address this issue of power line noise.

The following power line noise cases are of particular interest. Some have been previously discussed in semi-annual reports.

- K3GT in Allison Park, Pennsylvania: As previously reported, Mr. Gruber, with the assistance of Mike Martin of RFI Services helped the FCC investigate this case in May. Matthew Urick of the FCC Field Office in Philadelphia conducted the investigation, which is located near Pittsburgh. Also present was the complainant, Bob Thacker, K3GT. The utility in this matter, Duquesne Light & Power, had wanted to charge the complainant for RFI investigations.

Although this problem had been going for over a decade, Mr. Gruber reports that they were able to demonstrate to the FCC that the noise was coming from a number of poles that they identified. By the end of the day, they had identified noise sources in all directions but one.

As a result of this investigation the FCC had issued a letter to the utility. Despite the ARRL's exceptional effort to hand this case for enforcement to the FCC, the FCC gave them another 60 days to fix the problem. Remarkably, this was the same requirement afforded by the Commission in their first letter to the utility dated December 17, 2002. For the record, a complete list of FCC letters in this matter is as follows:

FCC Letter Issued in K3GT Case	Date
Duquesne Light Company #1	12-17-2002
Duquesne Light Company #2	09-11-2003
Duquesne Light Company #3	03-17-2005
Duquesne Light Company #4	07-27-2009
Duquesne Light Company #5	07-06-2011

Although the utility appears to have fixed the sources that were identified during the investigation, they were unable to find the remaining sources. They have claimed by letter to the Commission that the remaining sources are being caused by signage. They previously made similar claims before the investigation. Mr Gruber reports however, that the noise signatures were consistent with power line noise sources – not signage. Furthermore, both Mr. Martin and the FCC's Matt Urick agreed at the time that this was power line noise – not a sign.

Subsequently, Mr. Hare visited the complainant for a meet and greet session.

During this time, without any locating equipment, he assessed the situation. Given the length of time that had transpired since the FCC's last letter, and uncertainty regarding some of the sources, the complainant has agreed to a start over. Mr. Thacker has borrowed our ARRL locating equipment and presently doing an evaluation of the remaining problem.

- AA9VI in Northbrook, Illinois: As previously reported, this case was investigated by EMC Committee member Brian Cramer, W9RFI. Also present was Committee Chairman Kermit Carlson. It had also been previously investigated by the FCC and first reported to the ARRL on December 10, 2007. At the time of Mr. Cramer's investigation, the FCC field agents had been unable to locate the source of the problem.

Mr Cramer has now taken employment with ComEd. As a result, Mr. Cramer can no longer represent ARRL interests in this case. Mr. Gruber is presently following up with the complainant for an update. This case is ongoing, some improvement has been seen but interference remains.

- W0ZK in Northglenn, Colorado: This is another case that seems to have been dropped by the FCC. The noise started in early 2007 and was investigated by ARRL personnel, including TC Bob Witte and EMC Committee member Ron Hranac, N0IVN in early 2008. Bob Witte subsequently provided a report on the RFI on March 26, 2008. It identified several sources, and as a result, the ARRL Letter is issued on March 27, 2008.

In July of 2008, Bob Witte emailed Mike Gruber for update. Mr. Gruber reported that Riley had just retired on July 3rd and that he no longer has a contact at the FCC. Mr. Witte then emailed Jon Sprague of the FCC's Denver office asking for options. Kathy Berthot issued the first FCC letter on August 7, 2008. Subsequently, Laura L. Smith issued a second FCC Letter on February 20, 2009. Approximately three months later, Ms. Smith reported that Xcel Energy has retained outside counsel in this matter.

During an ARRL Convention, Mr. Gruber visited the site on June 1, 2009. He conclusively locates two sources using signature analysis. In addition, he observed a third offending noise source that ceased before he could pinpoint it. Later that September, Ms. Smith asks complainant for an update. She also reported that she had discussed this case with Xcel's attorney. Two months later, Mr. Witte asks Ms. Smith for an update. He also reported that Xcel did not appear to have taken any new action on this case.

In October of 2010, Ms. Smith reported that she was checking on case status with the Denver Field Office. In September 2011, however, the complainant reported that his case appeared to have been dropped. He was not able to get a response from either the FCC or utility. The last report from the complainant in the second half of 2012 indicated that the noise continues, although intermittently at times. This case remains ongoing.

- W4FGC in Lakeland, Florida: Although this case is now over ten years old, it was never fixed. Mr. Gruber reports that he has spent probably more time on this case than any other. Despite his effort, little or no improvement occurred as a result of sources located by the utility. Unfortunately, this case is now considered closed unless we hear anything further from the complainant. Mr. Flynn is now 91 years old and no longer able to continue the Power Line Noise battle. We have, however, decided to send him an official Certificate of Appreciation.
- W2PM in Ramsey, NJ: This case involved a 69 kV transmission line with a tower in the complainant's backyard. The utility's RFI investigator reported that the noise was fixed and the case closed. The complainant in this matter appears to have dropped his complainant. This case is now considered closed unless there is anything further from the complainant.

This case was first reported the ARRL in May of 2009. Mr. Gruber believes this would make a great example case for stations near high voltage transmission lines. A power line noise case in the vicinity of transmission lines has always been problematic with the FCC, even if the lines were not the source.

PAVE PAWS

Mr. Hare reports that requests for Longley-Rice modeling of potential repeater systems has slowed down, but that ARRL will continue to help on request.

Broadband over Power Line (BPL):

Broadband over power line (BPL) is the use of electrical wiring or power-distribution lines to carry high-speed digital signals. There are two types of BPL of concern to amateurs. Both *in-building* and *access* BPL have signals that occupy most or all of the HF range, extending into VHF. The power-line or electrical wiring can act as an antenna and radiate these signals. In-building BPL can be used to network computers within a building. It uses the building wiring to carry digital signals from one computer to another. Most in-building BPL operates under the [HomePlug](#) industry specification, which does not use the Amateur bands and thus poses no significant threat to Amateur operation.

Access BPL provides broadband Internet access to homes and businesses, using a combination of techniques and wiring. As of December 2012, there are only a handful of BPL systems still in operation in the US and none are being expanded in any way as the major US BPL manufacturers have all shut down any production of BPL equipment. At this point, Ed reports that most remaining systems do not use the ham bands. The BPL system operated by the French Broad EMC in North Carolina, however, does use the Amateur bands. In late 2011 testing, ARRL staff found that this system also does not notch the NTIA bands and it was operating well above the FCC limits. Because the system uses IBEC equipment, ARRL held off on filing a complaint on this until it could learn how IBEC's bankruptcy would affect the operation of the system, but since it

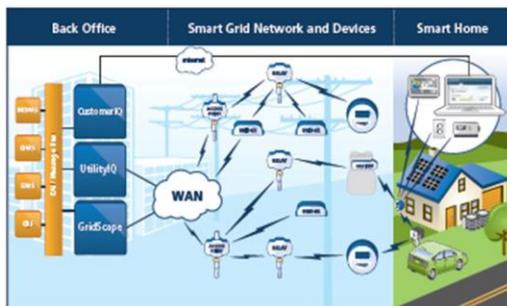
appears that the system will continue in operation, ARRL will prepare and file a complaint with the FCC.

BPL is also one of several options for the developing smart-grid technologies, although it is far from being the front runner in current smart-grid deployments. The reliability of using BPL on overhead and underground distribution lines is not sufficient to make BPL the first choice of smart-grid backbone technology.

Smart-Grid and Related Standardization

Mr. Ramie, KI6LGY, has prepared the following report on the following EMC issues for Amateurs:

1) Smart Metering using 902-928MHz band. This diagram shows the residential smart meter connecting to the utility smart grid network and devices. (local repeaters and access points) Note that the metering backhaul system commonly used in California is meshed frequency-hopping spread-spectrum (FHSS).



In Northern California, GE or L+G meters are outfitted with SilverSpring Networks 310 radio cards. (shown below)



These produce 2-20mS duration packets, adding up to 45 seconds/day of transmission. (That's a very low duty cycle) The consumer-side radio is a 2.4GHz narrow-band ZigBee device running SEPI.0 firmware.

Here are the specifications for the NIC300 family of meter cards:

NIC 300 product family

NAN communications Data rates: 100 kbps
Spread spectrum: FHSS
Transmitter output: 27 to 30 dBm (500 mW to 1 W)
Receiver sensitivity: -97 dBm for 1% PER
HAN communications Protocols: IEEE
802.15.4,
ZigBee Smart Energy Profile 1.0
Frequency: 2.4 GHz ISM Band
Transmitter output: 20 to 23 dBm (100 to 200 mW)
Receiver sensitivity: -97 dBm for 1% PER

2) Access Points (neighborhood concentrators) also use this band. (specifications below)



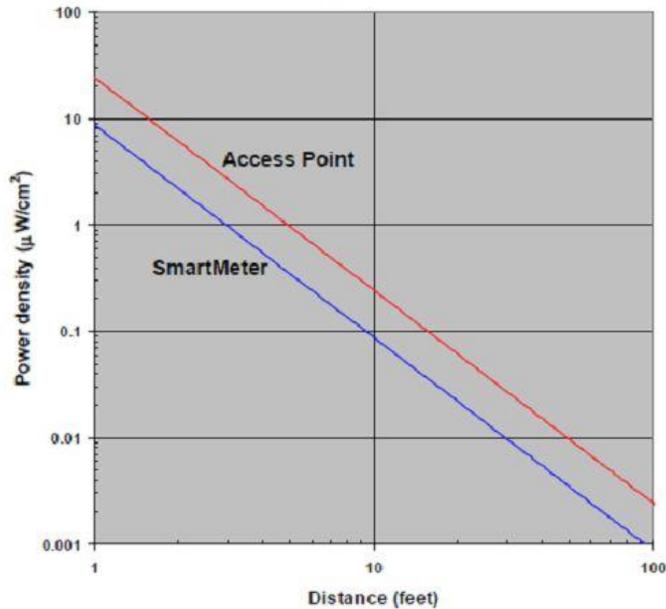
Specifications:

Communications	Data rate: 100 Kbps Frequencies: 902-928 MHz (North America) 915-928 MHz (Australia) 902-907.5, 915-928 MHz (Brazil) Spread spectrum technology: FHSS Transmitter output: 30 dBm Output impedance: 50 ohms Receiver sensitivity: -97 dBm for 1% PER WAN: Cellular, Ethernet, and Satellite
Protocols/Security	Addressing: Internet Protocol version 6 (IPv6) Security: Secure Hash Algorithm 256 bit (SHA-256) RSA-1024 and/or ECC-256 Encryption: Advanced Encryption Standard (AES-128 or AES-256)
Physical Interfaces	Antenna connector: N Type, Female Antenna: J-Pole or High-Gain Directional

Access points like this (or repeaters) have much higher duty cycles as they handle as many as 5,000 meters each. They also have better antennas, like the 0dBi J-pole shown above. If there was going to be an interference problem on 900MHz, it would most likely be with one of these. RF field strengths for smart meters and access points is shown below from a PG&E-commissioned report.

Examples of RF Fields Commonly Found in the Everyday Environment in Relation to SmartMeter™ System Operation	
RF Source	Power Density ($\mu\text{W}/\text{cm}^2$)
Immediately adjacent to a SmartMeter™ device (1 foot)	8.8
Immediately adjacent (1 foot) to a SmartMeter™ access point if elevated to height of transmitter	24
Adjacent to 25 foot high SmartMeter™ access point at ground level	0.03
Installed microwave oven- FDA allowable at 5 cm from door [FDA, 2009]	5,000
Typical RF field in kitchen with operating microwave oven [1 meter] [Mantiply, et al. (1997)]	10
Cell phones (at head) [Mantiply, et al. (1997)]	30 – 10,000
Cell phone base stations at ground level (maximum) [WHO (2006)]	1-12
Walkie-Talkies (at head) [Mantiply, et al. (1997)]	500 – 42,000
Wi-Fi wireless routers, laptop computers, cyber cafes, etc., maximum (~1 meter for laptops, 2-5 meters for access points) [Foster (2007)]	10-20
Median exposure to FM radio and TV broadcast station signals [Tell and Mantiply (1980)]	0.005

Maximum Power Density vs. Distance for SmartMeter Components



3) *Ken Leisten (K6DND) complained about a PG&E access point back in October, 2011. Mr Raime tried to locate this source 2M/440 Elk log-periodic antenna but could not positively identify the offender. The following photo shows Mr Raime's setup.*



Mr Leisten felt that his interference was coming from this unit, but Mr Raimé thought it was too far away from his home and the interfering signal faded and recovered before we got to this location. Mr Leisten asked PG&E to replace it, they did, and that made no difference.



A new investigation is needed here, and Ed Hare has ordered an appropriate antenna for the work. We may want to capture a spectrum plot of this case if it is still on-going. No formal complaint has occurred, although Mr. Leisten said he wanted to pursue one.

In-Premises BPL & HF interference

HomePlug modems notch the ham bands by 25dB. HomeGrid Forum notches them to 35dB. Hams may still experience HF interference from these modems if they're nearby or sharing the same transformer secondary. (it's conducted interference which can re-radiate from unshielded power wiring) Shut-down is the only mitigation. (these two modems can be replaced by a piece of CAT-5 cable for a few dollars)



Distribution Automation Equipment

This kind of equipment will soon be widely deployed to enable smart grid functions. They're Class A Industrial products with conducted emissions levels from their switching power supplies 10dB higher than consumer products. These devices will be installed on poles out in the neighborhoods at HF antenna heights. (see photo)



Will there be interference? How will any interference be mitigated? Are smart grid EMC Standards complete? (NO)

Trying to get EMC noticed...

September, 2009: The IEEE-EMC Society asked Mr Raime to address P2030 at their Plenary session AND all three working group sessions at IBM-Watson Research Center. The Presentation was accepted. Brian Cramer, W9RFI, from our committee got one paragraph accepted into P2030n about the need for EMC.



January, 2010: IEEE-EMC/SD-COM White paper was given at the P2030 meetings in Santa Clara, CA.



All three working groups declare that no EMC will be in P2030.

Finally got noticed...

September, 2010: Dave Wollman of NIST proposed the charter for the EMII working group under the Smart Grid Interoperability Panel (SGIP). Eight months are allocated for generating recommendations to the Governing Board. (the report will be done in 3Q/2012)

NIST

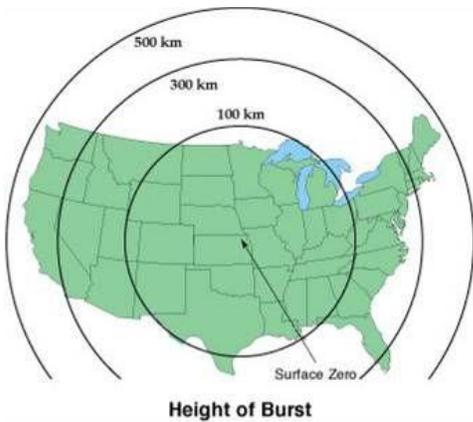


SGIP Mandates:

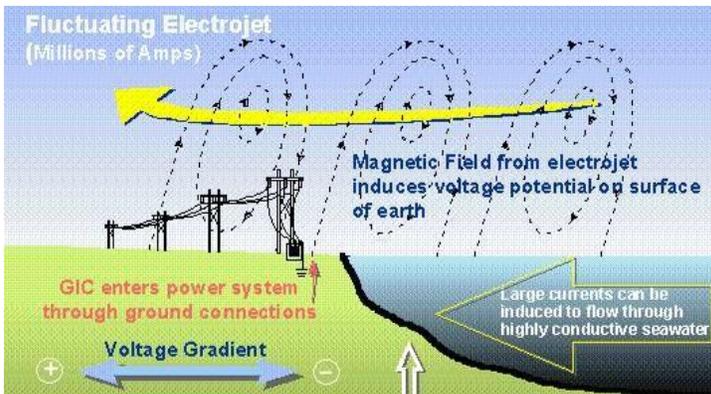
- *Identify standards for “Smart Grid”*
- *Identify missing standards and “gaps”*
- *Develop “priority action plans” (PAPs) to close gaps*
- *Provide deep technical reviews in key areas*
- *Coordinate these plans with Standards Organizations*

Progress in three areas at the EMII Working Group:

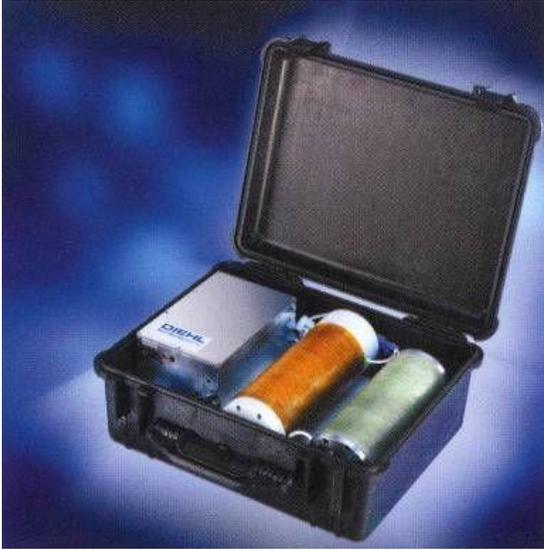
- 1) High-level EM Disturbances
- 2) High-altitude Electromagnetic Pulse (HEMP) created by a nuclear detonation in space



- 3) Geomagnetic Storms created by solar activity have created regional power blackouts in the past due to the creation of severe harmonics in large transformers.



Intentional Electromagnetic Interference (IEMI) caused by electromagnetic weapons used by criminals and terrorists. This unit is commercially available in Europe.



International standards organizations are dealing with protection from these threats for civil equipment and systems. In addition, there are questions being asked by Congress (7/21/09 Dept. of Homeland Security hearing) about whether these high-level EM threats are being considered in the Smart Grid program. In particular, the **IEEE EMC Society**, with support from its **Technical Committee 5 (HPEM)**, is developing a Standard Practice for protecting publicly-accessible computers from EM weapons (IEMI). Further **CIGRE** has just begun work on protecting substation control electronics from IEMI. Finally, the **International Electrotechnical Commission (IEC)** has been working for 20 years developing a body of standards and reports (20 in all) to protect civil electronic equipment and systems from HEMP and IEMI. It's likely that at least some of this work will be recommended for adoption by the EMII Working Group.

2) Protective Relay EMC Standards in the US & EU

This chart shows the IEEE or IEC testing for EMC required in the US and EU, respectively:

	Emissions	Immunity
Conducted	IEC 60255-25	IEC 60255-22-6
Radiated		IEC 60255-22-3 IEEE C37.90.2
Power-line	IEC 61000-3-2 IEC 61000-3-3	IEC 61000-4-8 IEC 61000-4-9 IEC 60255-11 IEC 60255-22-7
ESD		IEC 60255-22-2 IEEE C37.90.3
EFT		IEC 60255-22-4
Surge		IEC 60255-22-5
Surge Withstand		IEC 60255-22-1 IEEE C37.90.1

Mr Raime suggested that seven gaps in immunity testing could be identified from this table: (tests that are needed in the EU, but not in the US)

- Surge
- Conducted RF Immunity
- Power-frequency Magnetic Fields
- Pulsed Magnetic Fields
- AC Dips/Interrupts
- DC Dips/Interrupts & AC ripple
- Power-frequency Immunity

These seven gaps, and others, will be identified in our report to the SGIP Governing Board. The Board can:

- Ignore our immunity recommendations
- Authorize a Priority Action Plan (PAP) to directly address these gaps
- Authorize SGTCC action on Certification

3) Smart Grid Testing & Certification Committee

"Creates and maintains the necessary framework for compliance, interoperability and cybersecurity testing and certification for recommended smart grid standards."

Recent efforts include preparation of the Interoperability Process Reference Manual (IPRM). It will be used by Interoperability Testing and Certification Authorities (ITCAs) who must be (or must use) ISO-17025 accredited test labs for Certifications.

The EMII Working group will recommend that EMC immunity Standards be required for Smart Grid products Certified by ITCAs. These Authorities will then identify what EMC Standards will need to be met.

Progress in the Power & Energy Society



IEEE-1613 Extension for "Environmental and Testing Requirements for Communications Networking Devices Installed in Transmission and Distribution Facilities." IEEE-1613.1 will add the seven gap immunity tests identified above. Balloting in 3Q/2012

More immunity tests coming?

The IEC 61000-6-5 Generic Immunity Standard for Power Station and Substation Environments is due for revision. New disturbances and associated immunity testing methods have been developed since 2002. SC-77A, chaired by Dr. Bill Radasky, will

begin considering them in the new update. Balloting is probably several years away, however.

Mr Raime's Conclusions

- 1) *We need to understand if utility FHSS emissions on 902-928MHz will have an adverse impact on this band for our members. (new investigation needed in Santa Clara)*
- 2) *We need to stay vigilant to identify any HF interference from In-Premises BPL modems of any type. (keep in contact with consortia)*
- 3) *We need to advocate for additional, realistic immunity testing and test levels for Distribution Automation and Substation equipment. (by staying active in SGIP)*
- 4) *We need to help John Tengdin of IEEE-PES get the seven "gap" immunity Standards included in the 1613.1 extension. (by joining his working group to help draft the text)*
- 5) *It would be wise for this Country to require mitigations be in place for high-level EM disturbances at major utility nodes. (high-impact low-frequency events) We should advocate for such rules.*

Automotive EMC:

The Headquarters staff continues to send all reports of automotive EMC problems to interested people in the automotive industry. While these reports are advisory, they are helpful to the industry in planning for future designs. Mr. Steffka is also planning an evaluation of hybrid and electric vehicles' HF band RFI characteristics. He continues to help prepare automotive related responses to Technical Information Services (TIS) questions for ARRL members.

Cable Television:

As a whole, the cable industry continues to do a good job at adhering to the FCC's regulations about signal leakage and interference. ARRL has received only a few reports of problems, indicating that most cable systems are either clean or are addressing complaints effectively. Only a handful of these cases have required Mr. Hranac's involvement and ARRL follow up. There have been some cases involving wideband noise in the MF and HF range that were initially thought to be cable TV-related interference, but after investigation were found to be Part 15 or other devices coupling interference to the cable TV support strand and coaxial cable shield outer surface via National Electrical Code and/or National Electrical Safety Code required neutral bonds.

DSL, U-Verse & Home Phone Networking Alliance

Mr. Beatty continues to assist with broadband service complaints to the ARRL. Only a handful of complaints were received since January.

Dr. Strauss indicates he has nothing new to report relative to the Committee.

RFI-Case Database:

The ARRL HQ staff maintains a database of RFI reports and cases. This is used primarily as a case-management tool for the several hundred RFI cases ARRL handles every year, but the information the Lab staff are gathering about types of interference cases, involved equipment and frequencies will provide a wide range of reporting capability. Here are some statistics from the database for the 2nd half of 2012 and compared to the four previous years:

Category of Case Reported to ARRL Lab/EMC Engineer	2008	2009	2010	2011	2012-1	2012-2
BPL	2	1	3	0	0	0
Unknown Unintentional Radiators	49	65	57	78	23	43
CABLE TV	11	26	8	7	2	1
Satellite TV						
Computing Devices and Modems	15	21	4	7	1	2
Power Line Noise	81	113	90	65	32	21
Plasma TV Receivers	8	12	10	14	4	1
Other Broadcast Receivers	3	2	7	0	2	2
Other Receivers	1	4	8	3	1	0
Other Transmitters	11	1	2	9	2	0
Broadcast Transmitters	2	2	3	4	6	0
Lighting Devices	12	12	15	13	2	2
Fence Systems	3	4	4	2	0	0
Battery Chargers	6	2	1	1	3	0
Wheelchair	0	0	1	1	0	0
Water Pump Systems	1	1	3	2	1	0
HVAC Systems	5	4	11	6	2	1
Alarm Systems including detectors	3	4	6	0	2	2
Other Appliances	12	7	3	8	6	1
GFIC / AFCI	5	1	1	1	1	4
AUTOMOBILE Systems	12	8	4	3	1	1
Manufacturing and Retail				0	0	0
Generated Noise	1	2	1			
AT&T U-Verse Systems	3	10	10	8	3	5
Other					21	15

It is important to note that power line noise has consistently been the most reported and problematic RFI problem reported to the ARRL Lab. As Committee member Ed Hare indicted, *more hams suffer from power line noise right now than will ever suffer from BPL.*

ARRL RFI Forums:

The two RFI forums remain ongoing in the ARRL forums pages. These forums provide self help and discussion for members. They are monitored and moderated by HQ Lab staff and other volunteers. The pages are:

- RFI - Questions and Answers
 - RFI questions and are answered by other members and RFI experts. Members can post questions and read answers about solutions to an RFI problem they are having. The link is:
www.arrl.org/forum/categories/view/20

- RFI - General Discussion
 - This forum is a place to discuss technical issues associated with RFI and Amateur Radio. The link is:
www.arrl.org/forum/categories/view/21ssion

Committees:

ARRL continues to be represented on professional EMC committees. Messrs. Hare and Carlson continue to represent the interests of Amateur Radio on the ANSI ASC C63[®] EMC committee. Mr. Hare is the Primary ARRL C63[®] representative; Mr. Carlson is the Alternate. Mr. Hare serves as the Vice Chair of Subcommittee 5, Immunity. Mr. Hare also leads the C63[®] committee's Task Force on testing below 30 MHz, which has completed a first draft of an intentional emitter measurement standard that correctly and scientifically extrapolates field strength measurements below 30 MHz. This draft is now in ballot and is expected to become part of the ANSI C63.10 standard on the measurement of unlicensed intentional emitters (transmitters). Mr. Ramie serves as the C63[®] Secretary and as a member of the Below 30 MHz Task Group. The C63[®] committee is working on developing industry standards for immunity, emissions and testing of electronic devices. ARRL serves as a resource to the committee to protect the interests of Amateur Radio. Subcommittee 1 continues to work on a variety of EMC projects, primarily related to test site standardization. Subcommittee 5 deals with immunity and immunity measurement issues. Subcommittee 8 deals with various types of medical equipment. The multiple ARRL EMC-Committee representation on C63 watches immunity and testing developments.

Mr. Hare also serves on the IEEE EMC Society Standards Development Committee (SDCom) as its Secretary. SDCom serves as the EMC Society standards board, overseeing the development of all IEEE EMC Standards.

Related to committee work, Mr. Hare also maintains informal contact with a number of industry groups, including HomePlug and the HomeGrid Forum (in-premise BPL industry groups), Society of Cable Telecommunications Engineers, Society of Automotive Engineers and the Electric Power Research Institute, as a few examples.

FCC Rules

As initially reported in the July 2011 EMC Committee report, Messers. Gruber and Hare have proposed five suggestions for changes in the FCC rules. These proposals remain under review and are included as Appendix C in this document. Also, in support of that effort, here is a summary of planned, recent and ongoing Lab activities:

- Radiated emissions limits below 30 MHz in FCC Part 15 rules for unintentional emitters such as plasma TVs.
 - Test and document an actual TV in Annapolis, MD.
 - Document cases from database.
- Lower limits in Part 15 for non-CFL lighting to possibly harmonize with the lower limits for fluorescent bulbs in Part 18 rules.
 - Document cases from database. Obtain and test bulbs.
- Better external labeling on packaging for Part 18 fluorescent bulbs and ballasts.
 - Document items sold in major stores.
 - Testing as required.
- Specific radiated and/or conducted emissions limits for certain incidental emitters such as motors or power lines.
 - Document large number of power-line cases.
- Pulse-width motor controllers used in appliances.
 - Test a number of devices that belong to staff and/or local hams.

The Future of EMC and Amateur Radio:

Interference to hams appears to be the present major work of the committee. Although immunity problems still do occur, this is being addressed at the national and international standards level. RFI from unlicensed devices poses a major real threat to Amateur Radio at this time. This will continue to require significant Committee and ARRL staff attention. To the extent possible with existing staff, or with additional resources, the ARRL should increase its contact with standards organization, industry groups and individual companies, and continue to work on all aspects of RFI problems and solutions.

ARRL's information about RFI can be read at:

www.arrl.org/radio-frequency-interference-rfi.

Respectfully Submitted,

**Kermit A Carlson W9XA
EMC Committee Chairman
ViceDirector Central Division**

Appendix A

**FINAL REPORT
ON THE 4TH JOINT CROSS-BORDER
EMC MARKET SURVEILLANCE CAMPAIGN
(2011)**

LED LIGHTING PRODUCTS

Appendix B



Reliable substation networking solutions that run 24/7. So you don't have to.

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Cisco 2000 Series
Connected Grid Router



Cisco 2500 Series
Connected Grid Switch

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Appendix B: As described in text, we were able to get consensus on using IEC 61850-3 as our model for utility product EMC testing. This Cisco advertisement references IEC 61850-3 standards.

Appendix C

FCC Rules

As previously reported in the July 2011 EMC Committee report, Messers. Gruber and Hare have proposed the following five suggestions for changes in the FCC rules. These proposals remain under review.

1. Presently there are no Part 15 radiated emissions limits for unintentional emitters below 30 MHz. This had been a relative non-issue until the proliferation of plasma TVs. Our experience has shown that direct radiation at HF from a plasma display can be problematic and difficult to fix. One suggestion therefore would be to add absolute radiated emissions limits in this case to the HF spectrum. (Note: In the cases looked at by the Lab, the interference was relatively short range. While reducing the frequency of the limits may not completely solve the problem, it should help in some cases.)
2. Fluorescent lights with electronic ballasts, electronic ballasts and CFLs typically operate under Part 18. Part 18 has a separate set of absolute limits for “RF Lighting Devices.” These limits are then broken down into consumer and non-consumer devices. Note: The limits are higher for non-consumer devices, similar to Part 15A and 15B for digital devices.

Quasi-Peak Part 18 limits from 3 to 30 MHz for consumer and non-consumer RF lighting devices are 48 dB_{μV} and 70 dB_{μV}, respectively. For consumer devices, these are the lowest of any specified limits in Parts 15 and 18 of the rules. It is also important to note that, in the case of Part 18 lighting devices, the FCC created a special set of lower limits just for them. Apparently, the difficulty in eliminating interference from a widespread proliferation of Part 18 bulbs in homes and neighborhoods is something that concerned the FCC when they wrote these rules.

Unlike fluorescent bulbs however, the new LED bulbs operate under Part 15. The limits for these bulbs are 56 dB_{μV} from 0.5 to 5 MHz, and 60 dB_{μV} from 5 to 30 MHz. These newer LED bulbs are becoming increasingly ubiquitous in many stores and homes. Unlike their Part 18 equivalent however, they have also become a source of interference. The suggestion would be to reduce the Part 15 limits for lighting devices to Part 18 lighting device limits from 3 to 30 MHz. Essentially, make the limits for Part 15 and 18 bulbs the same, thus reducing the RFI potential from newer LED bulbs before they become a major problem.

3. Part 18 rules specify labeling for RF lighting devices are as follows:

§ 18.213 Information to the user.

Information on the following matters shall be provided to the user in the instruction manual or on the packaging if an instruction manual is not provided for any type of ISM equipment:

- (a) The interference potential of the device or system*
- (b) Maintenance of the system*
- (c) Simple measures that can be taken by the user to correct interference.*
- (d) Manufacturers of RF lighting devices must provide an advisory statement, either on the product packaging or with other user documentation, similar to the following: This product may cause interference to radio equipment and should not be installed near maritime safety communications equipment or other critical navigation or communication equipment operating between 0.45–30 MHz. Variations of this language are permitted provided all the points of the statement are addressed and may be presented in any legible font or text style.*

As the above indicates, including (d), the RFI potential is not required to appear on the outside of the package. One could easily buy a fluorescent light or ballast and not know there are issues until he opens the box. The suggestion would be to require an obvious warning on the outside of the package, similar to what appears on the box of a Part 15 unintentional emitter. The suggested wording would be similar to its Part 15 equivalent. In addition, part c of the above rules should be referenced and give the location of this information.

4. Part 18 specifies two sets of limits for RF Lighting Devices – consumer and non consumer. (Note: Some manufactures specify Part 18A and 18B on their products, similar to Part 15. This is not spelled out in Part 18 however.) A quick look at a local “big box” store will show that many ballasts are non-consumer rated. The label is not on the box but rather in very small print in the device or on a sheet inside the box. The suggestion would be to require consumer and non consumer labeling on the outside of the box. The labeling must also be large enough to be obvious to the consumer at the time of purchase.

In addition, some fluorescent light fixtures with electronic ballasts do not specify the type of ballast inside. The suggestion would be to also add labeling to the outside of the box in the case of a light fixture. It should be clear to the consumer that the device is or is not suitable for residential use.

5. Add intentional emitter radiated emissions limits for Part 15 incidental emitters in the case of power lines, associated hardware and electric motors. Although power line noise is the most reported source of known interference to the ARRL, and often the most difficult to solve, there are presently no specified limits for power lines (or any other) incidental emitters.